WHAT IS CLAIMED IS:

1. A frame transfer device, which is connected to another frame transfer device by plural physical channels, comprising:

a means for maintaining logical paths which vary with user traffic and priority of the user traffic; and

a means for forming path frames having a fixed frame length and transfer schedule with respect to each path to transfer the user traffic.

2. A frame transfer device as claimed in claim 1, wherein the physical channels are optical channels that are defined by wavelengths.

3. A frame transfer device as claimed in claim 2, wherein m logical paths are used in correspondence with n physical channels (m / n: an integer 1 or more).

4. A frame transfer device as claimed in claim 3, further comprising a frame forming processor for selecting channels corresponding to each path to equally distribute the path frames belonging to the path.

5. A frame transfer device as claimed in claim 3, further comprising a frame restoration processor for terminating the path frames received with respect to each logical path, and restoring the path frames to user packets.

6. A frame transfer device as claimed in claim 3, further comprising a frame relay processor for selecting output channels corresponding to each path to equally distribute the path frames received via input channels, and transfers the path frames.

7. A frame transfer device as claimed in claim 4, wherein the frame forming processor includes:

buffers for storing user packets with respect to each logical path;

a frame forming section for reading the user packets out of the buffers, and forming path frames having a fixed frames length and individual ordinal numbers; and

a switch for selecting output channels based on identification information attached to each path frames, and outputting the path frames to the channels by round robin scheduling.

8. A frame transfer device as claimed in claim 7, wherein the frame forming section includes a means for padding a data field of a path frame to make up the path frame, when user packets stored in the buffer are not enough for the capacity of the path frame after a prescribed period of time.

9. A frame transfer device as claimed in claim 8, wherein the frame forming section forms no path frame, when there is no user packet to be transferred stored in the buffer.

10. A frame transfer device as claimed in claim 4, wherein the frame forming processor includes:

a standby buffer for storing information of each path frame in preparation for retransmission of the path frame;

a timer for receiving or monitoring a retransmission request from a subsequent stage for a certain period of time after transmitting the path frame, and deleting information of the path frame held in the standby buffer when the certain period of time has passed; and

a retransmission controller for instructing the standby buffer

to retransmit the path frame when there is a retransmission request .

11. A frame transfer device as claimed in claim 5, wherein the frame restoring processor includes:

a frame restoring section for receiving path frames from the channels and detecting frame errors;

buffers for storing the received path frames with respect to each path; and

a packet restoring section for restoring the path frames written in the buffers to user packets according to the ordinal numbers attached to the path frames.

12. A frame transfer device as claimed in claim 5, wherein the frame restoring processor further includes:

a timer for clocking a maximum interval of incoming path frames; and

a retransmission controller for transmitting a retransmission request for a path frame to the preliminary stage when the timer detects the loss of the path frame.

13. A frame transfer device as claimed in claim 11, wherein the frame restoring processor further includes:

a timer for clocking a maximum interval of incoming path frames; and

a retransmission controller for transmitting a retransmission request for a path frame to the preliminary stage when the timer detects the loss of the path frame.

14. A frame transfer device as claimed in claim 11, wherein the path frame includes at the header part:

a field for storing a path number to identify the logical path;

a field for storing an ordinal number attached to the path frame at the time of forming the frame; and

a pointer field for indicating positional information of the first user packet, which is stored in the payload part of the path frame.

15. A frame transfer device as claimed in claim 11, wherein:

the frame restoring section includes a means for reading path frames into buffers at subsequent stage using the ordinal numbers stored in respective path frames;

the packet restoring section, which restores user packets, includes a means for retrieving the first user packet stored in a path frame with reference to a pointer value of the path frame, and a means for identifying the position of the head of the next user packet with reference to packet length information stored in the first user packet.

16. A frame transfer device as claimed in claim 4, including at least one selected from: the frame forming processor, the frame restoring processor, or the frame relaying processor.

17. A frame transfer device as claimed in claim 16, further including a control frame transmitting means for transmitting a control frame indicating initiation of data transmission at the time of setting a new OCH connection between the frame transfer devices, and a control frame indicating termination of data transmission on an existing OCH at the time of disconnecting the OCH.

18. A frame transfer device as claimed in claim 17, wherein the control frame transmitting means executes transmission control according to increase and decrease in traffic between the frame transfer

devices.

19. A frame transfer device as claimed in claim 17, wherein the control frame transmitting means executes transmission control according to errors on OCHs connecting the frame transfer devices.

20. A frame transfer device as claimed in claim 18, wherein the control frame transmitting means executes transmission control according to errors on OCHs connecting the frame transfer devices.

21. A frame transfer device as claimed in claim 17, wherein the path frame length and transfer cycle are set according to an allowable delay period and burst property of user traffic.

22. A frame transfer device as claimed in claim 16, including a means for requesting disposal or retransmission of a path frame, when an error is detected in the path frame.

23. A frame transfer system, which is configured by interconnecting the frame transfer devices claimed in one of claims 15 to 20.

24. A frame transfer method, comprising steps of:

connecting frame transfer devices by plural physical channels and managing logical paths varied with user traffic and priority of the traffic; and

forming path frames that have a fixed frame length with respect to each logical path and operate on transfer schedule to transfer data.

25. A frame transfer method as claimed in claim 24, wherein the physical channels are optical channels, further comprising a step of transferring path frames on the optical channels.

26. A frame transfer method as claimed in claim 24, wherein m logical paths are related with n physical channels (m / n: an integer 1 or more), further comprising a step of interchanging information of the paths and channels.

27. A frame transfer method as claimed in claim 25, wherein m logical paths are related with n physical channels (m / n: an integer 1 or more), further comprising a step of interchanging information of the paths and channels.

28. A frame transfer method as claimed in claim 26, further comprising a frame transferring step for selecting channels corresponding to each logical path, and equally distributing path frames belonging to the path.

29. A frame transfer method as claimed in claim 27, further comprising a frame transferring step for selecting channels corresponding to each logical path, and equally distributing path frames belonging to the path.

30. A frame transfer method as claimed in claim 28, wherein the frame transferring step includes steps of:

transmitting a control frame indicating initiation of data transmission at the time of setting a new physical channel between network devices; and

transmitting a control frame indicating termination of data

transmission on an existing physical channel at the time of disconnecting the physical channel.

31. A frame transfer method as claimed in claim 29, wherein the frame transferring step includes steps of:

transmitting a control frame indicating initiation of data transmission at the time of setting a new physical channel between network devices; and

transmitting a control frame indicating termination of data transmission on an existing physical channel at the time of disconnecting the physical channel.

32. A frame transfer method, wherein a frame transfer device including control frame transmitting steps for transmitting a control frame indicating initiation of data transmission at the time of setting a new physical channel between network devices, and transmitting a control frame indicating termination of data transmission on an existing physical channel at the time of disconnecting the physical channel.

33. A frame transfer method as claimed in claim 30, wherein the control frame transmitting step controls transmission of the frames according to increase and decrease in traffic between the network devices.

34. A frame transfer method as claimed in claim 31, wherein the control frame transmitting step controls transmission of the frames according to increase and decrease in traffic between the network devices.

35. A frame transfer method as claimed in claim 30, wherein the control frame transmitting step controls transmission of the frames according to detection of errors on specified optical channels between network devices.

36. A frame transfer method as claimed in claim 31, wherein the control frame transmitting step controls transmission of the frames according to detection of errors on specified optical channels between network devices.

37. A frame transfer method as claimed in claim 30, further comprising a step of setting the path frame length and transfer cycle according to an allowable delay period and a parameter of burst property of user traffic.

38. A frame transfer method as claimed in claim 31, further comprising a step of setting the path frame length and transfer cycle according to an allowable delay period and a parameter of burst property of user traffic.

39. A frame transfer method as claimed in claim 30, wherein a frame transfer device includes steps of:

requesting disposal or retransmission of a path frame, when an error is detected in the path frame; detecting errors in received path frames;

timing a maximum interval between the incoming frames; and

requesting retransmission of a path frame, when an error is detected in the path frame at the timing step.

40. A frame transfer method as claimed in claim 31, wherein

a frame transfer device includes steps of:

requesting disposal or retransmission of a path frame, when an error is detected in the path frame; detecting errors in received path frames;

timing a maximum interval between the incoming frames; and

requesting retransmission of a path frame, when an error is detected in the path frame at the timing step.

41. A frame transfer method as claimed in claim 30, further comprising steps of:

storing a path number to identify the logical path in the header part of a path frame;

giving an ordinal number to the path frame; and

writing a pointer field indicating positional information of the first user packet, which is stored in the payload part of the path frame.

42. A frame transfer method as claimed in claim 31, further comprising steps of:

storing a path number to identify the logical path in the header part of a path frame;

giving an ordinal number to the path frame; and

writing a pointer field indicating positional information of the first user packet, which is stored in the payload part of the path frame.

43. A frame transfer system, including a means for defining logical paths, which varies with user traffic and priority of the traffic, between network devices interconnected by plural physical channels to transfer data; and forming path frames having a fixed frame length with respect to each logical path and operating on transfer schedule.

44. A frame transfer system as claimed in claim 43, wherein the physical channels include optical channels.

45. A frame transfer system as claimed in claim 43, further including a means for using n physical channels as m logical paths (m / n: an integer 1 or more), and equally distributing path frames to the corresponding channels.

46. A frame transfer system as claimed in claim 44, further including a means for using n physical channels as m logical paths (m / n: an integer 1 or more), and equally distributing path frames to the corresponding channels.

47. A frame transfer system as claimed in claim 45, further including:

a buffer means for storing data with respect to each logical path; and

a switch means for selecting output channels based on identification information attached to path frames, and outputting the path frames to the channels by round robin scheduling.

48. A frame transfer system as claimed in claim 46, further including:

a buffer means for storing data with respect to each logical path; and

a switch means for selecting output channels based on identification information attached to path frames, and outputting the path frames to the channels by round robin scheduling.

49. A frame transfer system, which interconnects network

devices by plural channels, and defines logical paths according to upper traffic and priority of the traffic to transfer path frames having a specified frame length and operating on transfer schedule, wherein:

the logical path stores user packets, forms the path frames, and is terminated by an input network device that transmits data on the light wavelength division multiplexing network, and an output network device that terminates the path frames and restores the frames to user packets.

50. A frame transfer system as claimed in claim 49, wherein the input network device includes:

a buffer means for storing user packets with respect to each logical path;

a frame forming means for reading the user packets out of the buffer, and forming path frames having a fixed frame length and individual ordinal numbers; and

a switch means for outputting the path frames to the optical channels by round robin scheduling.

51. A frame transfer system as claimed in claim 50, wherein the output network device includes:

a frame restoring means for receiving the path frames from the optical channels and writing the frames for each path into a buffer at a subsequent stage; and

a packet restoring means for restoring the path frames written in the buffer to user packets according to the ordinal number attached to each path frame.

52. A frame transfer system as claimed in claim 43, wherein the header part of the path frame includes:

a field for storing a path number to identify the logical path;

a field for storing an ordinal number attached to the path frame at the time of forming the frame; and

a pointer field indicating positional information of the first user packet, which is stored in the payload part of the path frame.

53. A frame transfer system as claimed in claim 52, wherein the output network device includes:

a means for controlling to read frames into a buffer at a subsequent stage using the ordinal number stored in each path frame at a frame restoring section; and

a means for retrieving the first user packet stored in the path frame with reference to a pointer value of the path frame, and a means for recognizing the position of the head of the next user packet stored in the path frame with reference to packet length information stored in the user packet retrieved before and retrieving a new user packet at a packet restoring section where the path frames in the buffer are restored to the user packets.

54. A frame transfer system as claimed in claim 43, wherein the network device includes a transmission control means for transmitting a control frame to indicate initiation of data transmission on the occasion of setting a new optical channel connection between the network devices, and a control frame to indicate termination of data transmission on the occasion of disconnecting an existing optical channel.

55. A frame transfer system as claimed in claim 43, wherein the transmission control means performs transmission control according to increase and decrease in traffic between the network devices.

56. A frame transfer system as claimed in claim 43, wherein the transmission control means performs transmission control according to detection of errors on specified optical channels between the network devices.

57. A frame transfer system as claimed in claim 43, wherein the path frame length and transfer cycle are set according to an allowable delay period and burst property of user traffic.

58. A frame transfer system as claimed in claim 57, wherein the path frame length is set so as to satisfy the allowable delay period, which is obtained by the sum of: a period for holding user packets in the buffer on transmitting side, a period for reading out the user packets as path frames, a period for transmitting the path frames on optical fibers, a period for holding the path frames in the buffer on receiving side, and a period for reading the path frames out of the buffer to restore the user packets.

59. A frame transfer system as claimed in claim 37, comprising steps of: obtaining the allowable delay period by the sum of a period for holding user packets in the buffer on transmitting side, a period for reading out the user packets as path frames, a period for transmitting the path frames on optical fibers, a period for holding the path frames in the buffer on receiving side, and a period for reading the path frames out of the buffer to restore the user packets; and setting the path frame length so as to satisfy the allowable delay period.

60. A frame transfer system as claimed in claim 38, comprising steps of: obtaining the allowable delay period by the sum of a period for holding user packets in the buffer on transmitting side, a

period for reading out the user packets as path frames, a period for transmitting the path frames on optical fibers, a period for holding the path frames in the buffer on receiving side, and a period for reading the path frames out of the buffer to restore the user packets; and setting the path frame length so as to satisfy the allowable delay period.

61. A frame transfer system as claimed in claim 21, including:

a means for obtaining the allowable delay period by the sum of a period for holding user packets in the buffer on transmitting side, a period for reading out the user packets as path frames, a period for transmitting the path frames on optical fibers, a period for holding the path frames in the buffer on receiving side, and a period for reading the path frames out of the buffer to restore the user packets; and

a means for setting the path frame length so as to satisfy the allowable delay period.

62. A frame transfer system as claimed in claim 43, wherein the network device includes a means for requesting disposal or retransmission of a frame, when an error is detected in the frame.

63. A frame transfer system, using the light wavelength division multiplexing on the communication network, in which network devices are interconnected by plural optical channels, logical paths are defined according to user traffic and priority of the traffic, and path frames having a specified frame length and operating on transmission schedule are formed with respect to each logical path, wherein:

the logical path includes: an input network device, which receives user packets, forms path frames, and transfers the path frames on the light wavelength division multiplexing network; an output

network device, which terminates the path frames and restores the path frames to user packets, a relay network device, which relays the path frames; and plural optical channels, which connect the network devices and are defined for respective wavelengths.

64. A frame forming processor, comprising:

a frame transmitting section, which uses n physical channels as m logical paths (m / n: an integer 1 or more), and selects channels corresponding to each logical path and equally distributing path frames having a fixed frame length formed for the logical path;

buffers for storing user packets with respect to each logical path;

a frame forming section for reading the user packets out of the buffers, and forming path frames having a fixed frame length and individual ordinal numbers; and

a switch for deciding output channels based on identification information attached to the path frames, and outputting the path frames to the channels by round robin scheduling.

65. A frame restoring processor, comprising:

a frame restoring section, which uses n physical channels as m logical paths (m / n: an integer 1 or more), receives path frames having a fixed frame length formed for each logical path, and detects frame errors;

buffers for storing the received path frames with respect to each path; and

a packet restoring section for restoring the path frames written in the buffers to user packets according to the ordinal numbers attached to the respective path frames.